Arthroplasty Today 1 (2015) 11–13

Contents lists available at ScienceDirect

Arthroplasty Today

journal homepage: http://www.arthroplastytoday.org/

Surgical technique

Extraction of a well fixed but fractured ceramic acetabular liner

David Ferguson, MB ChB, BSc (Hons), FRCS *, Robert Metcalf, FRCS

Huddersfield Royal Infirmary, Lindley, UK

A R T I C L E I N F O

Article history:
Received 20 October 2014
Received in revised form
15 December 2014
Accepted 16 December 2014

Keywords:
Ceramic
Fracture
Revision
Total hip replacement

A B S T R A C T

Ceramic fractures have been reported to occur in hip replacements, but the techniques used to extract a well fixed but fractured component are not commonly described. We present a case of ceramic liner fracture and validate a modification of a previously reported extraction technique that allowed us to save the acetabular cup and insert a polyethylene liner. With an increasing trend in ceramic bearing usage, it is likely that the number of ceramic liner fractures will increase and therefore knowledge of successful extraction techniques will be desirable.

Introduction

According to the National Joint Registry for England and Wales [1], there is an increasing trend towards using ceramic-on-ceramic (CoC) bearing total hip replacements, especially in younger patients. Although advances in ceramic material properties have led to improved resistance to fracture, this complication still exists. Contemporary ceramic fracture rates have been reported to range from 0% to 3.5% [2–4] and are likely to be caused by a combination of edge-loading and incorrect seating of the liner within the cup before impaction (canting). We present a case of ceramic liner fracture and validate a modification of a previously reported extraction technique [5].

Surgical technique

A thirty-two year old female presented to our department with a painful left hip and sensation of instability. Five years earlier, she had received a left sided total hip replacement at another institution for left hip osteoarthritis secondary to developmental dysplasia of the hip. This was performed through a posterior approach, and using an uncemented Corail stem and Pinnacle cup (Depuy Int., Leeds, England), and a ceramic-on-ceramic bearing (Biolox delta, Plochingen, Germany). A ceramic liner fracture involving the rim was noted post-operatively (Figure 1), but the liner remained securely fixed. We investigated the hip joint for infection and loosening, but ruled these out as causes for her symptoms. The computed tomography (CT) scans of her hip did show a prominent screw head between the cup and liner, which was later confirmed during surgery and removed. We believe that this was the cause of the liner malpositioning during the primary surgery and resulted in fracture during liner impaction. This phenomenon has previously been reported [6]. During the revision surgery, we exposed the acetabular and femoral components through the previous posterior approach scar. The femoral stem was securely fixed and the soft tissues around the hip looked healthy. The ceramic head was removed to increase exposure of the acetabulum. We found the lip of the ceramic liner was deficient inferiorly and the liner itself was not concentric within the cup. There was no movement between the liner and the cup. Attempts to remove the liner with the Pinnacle extraction tool (Depuy Int., Leeds, England) were unsuccessful, leading us to remove the liner by causing further ceramic fracture. In order to do this we created a small hole in the centre of the ceramic liner using two 1 mm ConMed Osteon (ConMed Linvatec, Largo FL, USA) diamond tipped burs operating at 40,000 rpm and attached to an Osteon Handpiece (ConMed Linvatec, Largo FL, USA). It was not necessary to bur through the entire thickness of the ceramic, which took approximately 20 min (Figure 2). Continuous irrigation and suction was used throughout the process to optimize ceramic debris removal. The use of a small bur prevented the irrigation fluid and ceramic

No author associated with this paper has disclosed any potential or pertinent conflicts which may be perceived to have impending conflict with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.artd.2014.12.003

* Corresponding author. Acre Street, Lindley HD3 3EA, UK. Tel.: +44 1484 342000.
E-mail address: david.ferguson5@nhs.net

http://dx.doi.org/10.1016/j.artd.2014.12.003

Fig. 1. Postoperative radiograph showing fracture of the acetabular ceramic liner.

debris from spraying the surrounding soft tissues. A fine Frazier suction probe continuously removed the irrigation fluid from the acetabular cup, thus further limiting any ceramic debris spread. As the patient was placed in the lateral position, the acetabular cup held the irrigation fluid under gravity. A 10.5 cm Charnley Retractor pin (Depuy Int., Leeds, England) loaded in a 'T-handle' was then

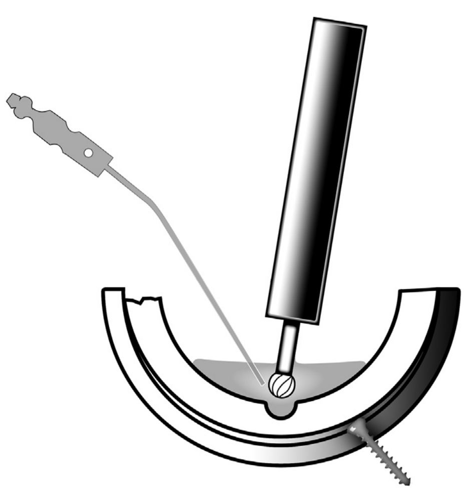

Fig. 2. The extraction technique begins by creating a hole half way through the base of the ceramic liner using a diamond tipped bur. A continuous supply of water irrigation via syringe helps to cool and lubricate the bur, and also prevent ceramic debris from scattering. A Frazier suction probe can be used to remove the irrigation fluid. Striking a Charnley pin (Depuy Int., Leeds, England) into the cavity creates a controlled fracture that allows the liner to be removed.

Fig. 3. Revision of bearing surfaces to ceramic head with titanium sleeve, and highly cross-linked polyethylene liner.

used to punch into the ceramic hole and fracture the liner into 3 large segments. The cup was inspected for stability and one of the prominent 6.5 mm cancellous bone screws was removed. Finally, the acetabular liner was revised to a cross-linked polyethylene component (Figure 3).

Discussion

We found one other case report that described ceramic liner extraction from a metal cup [5]. Their technique involved using a dental drill with irrigation to create a hole through the ceramic liner, then impacting a Steinmann pin to cause fracture. We validate this method as being successful based on our modified technique using a diamond tipped bur to create a hole half way through the ceramic, and a Charnley Retractor pin (Depuy Int., Leeds, England) to propagate a fracture. We believe that this bur hole is vital to initiate and propagate a controlled ceramic fracture. Biolox Delta ceramic is a hard material with both high compressive strength (3500 MPa) and toughness. According to the Food and Drug Administration [7], Biolox Delta ceramic has a mean static axial compressive fracture load greater than 247 kN when using Biolox Delta ceramix heads. Using stainless steel osteotomes are more likely to cause deformity to the osteotome itself rather than the ceramic liner. Unlike sandwich liners that have polyethylene between the ceramic and metal, the Pinnacle system has a 'taper lock' mechanism with scallops around the edge. There is an alternative bearing extraction tool with 3 prongs that slip into the scallops, and transmits vibrations to release the ceramic liner from the taper lock. If the liner is placed incongruently, then this device does not work. Our experience suggests that preservation of a well-fixed cup can only be achieved by fracturing the ceramic liner further. In this case, we chose to insert a highly crossed linked polyethylene liner despite fracturing the ceramic. Distortion of the cup whilst inserting at the time of primary surgery or canting of the liner may have contributed to the ceramic fracture [8,9]. Damage to the cup-liner taper made the use of a polyethylene acetabular liner more preferable. A ceramic head was used to resist abrasive wear from any ceramic particles left in the joint and possibly embedded within the polyethylene [10]. The head also contained a titanium sleeve, which is desirable to reduce the risk of trunionosis [11]. We removed all macroscopic ceramic debris and irrigated the site with copious amounts of saline to minimize the risk of 3rd body wear. It is difficult to know if all microscopic debris was removed, and what volume of debris would be acceptable before wear rates increased. For this reason, we recommend this technique should only be used if there are no other options.

Summary

As a general rule to drilling holes in ceramic, we suggest that a combination of low speed, moderate pressure and high volume of water irrigation should be used. Drills and burs that create black ceramic are probably overheating and require less speed or pressure to preserve the tool. Water irrigation provides lubrication, cooling and removal of ceramic debris. Measures should be taken to ensure adequate removal of ceramic debris with as little contamination of the surrounding soft tissues as possible.

References

[1] National Joint Registry for England and Wales. 9th Annual Report. 2012. http://www.njrcentre.org.uk/NjrCentre/Portals/0/Documents/England/Reports/9th_annual_report/NJR%209th%20Annual%20Report%202012.pdf.

[2] Ha YC, Kim SY, Kin HJ, et al. Ceramic liner fracture after cementless alumina-on-alumina total hip arthroplasty. Clin Orthop Relat Res 2007;458:106.

[3] Parvizi J, Adeli B, Wong JC, et al. A squeaky reputation: the problem may be design-dependent. Clin Orthop Relat Res 2011;469(6):1598.

[4] Massin P, Lopes R, Masson B, et al. Does Biolox Delta ceramic reduce the rate of component fractures in total hip replacement? Orthop Traumatol Surg Res 2014;100 Suppl 6:S317.

[5] Butt U, Knowles D. A fractured and immovable ceramic liner in a screw-fixed acetabular shell during total hip arthroplasty: a case report. J Orthop Surg (Hong Kong) 2012;20(3):395.

[6] Lee SC, Jung KA, Nam CH, et al. Acetabular screw head-induced ceramic acetabular liner fracture in cementless ceramic-on-ceramic total hip arthroplasty. Orthopedics 2010;(5):33.

[7] Summary of Safety and Effectiveness Data. Food and Drug Administration (US). http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cftopic/pma/pma.cfm?num=p070026s004.

[8] Hamilton WG, McAuley JP, Dennis DA, et al. THA with Delta ceramic on ceramic: results of a multicenter investigational device exemption trial. Clin Orthop Relat Res 2010;468(2):358.

[9] McAuley JP, Dennis DA, Grostefon J, et al. Factors affecting modular acetabular ceramic liner insertion: a biomechanical analysis. Clin Orthop Relat Res 2012;470(2):402.

[10] O'Brien ST, Burnell CD, Hedden DR, et al. Abrasive wear and metallosis associated with cross-linked polyethylene in total hip arthroplasty. J Arthroplasty 2013;28(1): 197, e17.

[11] Jack CM, Molloy DO, Walter WL, et al. The use of ceramic-on-ceramic bearings in isolated revision of the acetabular component. Bone Joint J 2013;95-b(3): 333.